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ELECTRIC-ARC SMELTING FOR THE PRODUCTION OF DISC-SHAPED MILLERS

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Electric-arc smelting is the most economical method of producing, with a minimum consumption of steel, composite cutting tools made of high-speed steel. The electrodes may be either forged or cast in high-speed steel. They can also be smelted from high-speed steel by introducing alloy components into the composition of the plating mixture and applying it in a thick layer on the surface of low-carbon steel products.

Disc-shaped millers made entirely of high-speed steel are not sufficiently durable. To increase their durability the use of electric-arc smelting was proposed (introduced in the Izhor Plant by a group of workers, I. I. Poporov foreman). The body of the miller was made of low-carbon steel. Special electrodes applied a covering layer at its circumference. It was very difficult to select a proper mixture, as the core of the electrode was an ordinary low-carbon steel wire 5 millimeters in diameter.

After much experimenting, we obtained a high-speed steel alloy with a requisite hardness of R_C equals 60-64 by means of heat-finishing operations.

The technological process of producing composite millers consisted of the following operations. Prepared cores were coated with a special composition (see below). The thickness of the coating was 1.0-1.5 millimeters per side. The coating stabilized the arcs and protected the fused-on metal from the action of nitrogen and oxygen in the circumambient atmosphere, and also ensured high-speed steel quality in the covering layer. The coated electrodes were tempered in an annealing furnace under natural conditions for 1 to 3 hours.

Composition of the Coating

Chromium	18.0	Chalk	9.0
Molybdenum	10.8	Marble	18.0
Vanadium	12.1	Quartz	2.7
Tungsten	17.0	Fluorspar	4.5
Carbon	3.3	Concrete	1.0
Ferrotitanium	3.6		

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The body of the miller rested in a device made of red copper to retain the fused-on metal and secure the proper form in smelting. Smelting took place in a direct-current machine, although equally good results were obtained from alternating current. The method employed in smelting does not differ from the method used in welding with thickly coated electrodes (a current density 40 - 45 amperes per millimeter of diameter).

The smelted half-finished millers were hammered and the resultant disks were tempered and tooled. The material prepared for millers was subjected to heat finishing according to the following method.

The object is smelted and the semifinished product is then placed in hot sand 200 - 300 degrees in temperature.

Next the product is annealed at 940 - 1,100 degrees; annealing after peening is at 950 - 1,100 degrees.

Quenching is performed after tooling by slowly heating to 900 - 1,000 degrees and then rapidly heating to 1,200 - 1,300 degrees, for one minute at this temperature. The product is cooled by a jet of dry compressed air or linseed oil.

High-temperature annealing is at 650 - 600 degrees for 5-minute periods. If, however, the composition of the steel is unknown, the annealing temperature is to be 570 degrees.

Next the cutting parts of the miller were polished. The quality of the cutting parts was controlled, at first by means of experiments on their hardness, later by experiments in production conditions.

Factory experiments showed that composite millers were more durable than millers made entirely of high-speed steel. A highspeed steel miller 5 millimeters thick and 150 millimeters in diameter needs regrinding after 2 hours of service and can be reground 5 or 6 times. A composite miller will operate without regrinding for 2 to 6 hours with the same number of regrindings.

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